

REMARKS

Claim 12 has been amended. Claims 29-32 have been added. The claims remaining in the application are 1-32.

Specification:

The Examiner has rejected the title of the invention because it is not descriptive. Applicant has amended the title so that it is more descriptive.

Rejection Under 35 U.S.C. § 102

The Examiner has rejected claim 12 under 35 U.S.C. 102(b) as being anticipated by Abileah et al. (U.S. 5,499,126). This rejection is respectfully traversed.

Applicant was aware of the Abileah et al. patent when the present application was filed. In particular, the present application briefly discusses Abileah et al., which discloses the design of liquid crystal displays (LCDs) that incorporate color tuned retarders that are aligned with RGB LCD sub-pixels. As the present application discloses the concept of spatially variant retarders which have a retardance variation that corrects for a spatially variant retardance of an LCD, and does not cover the Abileah-like concept of color tuned retarders that are integrated and aligned into an LCD with color sub-pixels, the Abileah et al. patent was considered to be only generally relevant, and was not discussed further. Since the Examiner has concluded that the Abileah et al. patent actually anticipates the present application, the Applicant will discuss the specific differences more explicitly.

Abileah et al. begins by discussing a prior art device (see Figure 1 and Col. 3, lines 41-57) which is a multi-colored pixel device, with red, green, and blue sub-pixels, in which the device performance is color tuned by providing cell gap thicknesses corresponding to the sub-pixels that have color tuned extents (thicknesses "d"). Specifically, the thicknesses of the color filters 16 are varied so that the cell gap thickness (which is filled with LC materials) is variable with reference to the interior surfaces of transparent conductors 18. Abileah et al. comments that such multi-gap displays are very difficult and expensive to manufacture. Moreover (see Col. 5, lines 34-37 and Col. 6, lines 8-48), the prior art Figure 1 device provides retarders with a single retardance such that peak

contrast and contrast response with angle both vary with color. Abileah et al. also discusses (see Col. 7, line 9 through Col. 9, line 63) another prior art device (Figure 4) wherein red, green, and blue specific color filters are used, but the cell gaps are identical for the different colors, and the peak and angular contrast response than varies significantly from color to color.

Abileah et al. then sets out (see Col. 9, lines 64-67) to provide improved LCDs in which good contrast can be provided for all colors without needing the multi-gap configuration of Figure 1. Abileah et al. describes eight different embodiments for the construction of a multi-color LCD in which color specific retarders are integrated into a display panel with the retardance and spatial location of the retardance controlled to support multi-color sub-pixelization. According, the first such device (see Figure 11) is described (see Col. 16, lines 27-37) as incorporating personalized red, green, and blue uniaxial retardation films and corresponding color filters. Abileah et al. further describes (see Col. 17, lines 5-12) this device as having a constant cell gap thickness “d” which is optimized for green, but formed identically over the red and blue regions as well, such that blue and red light would suffer leakage and contrast loss (see Col. 17, lines 41-67), except that the color personalized retardation films all have compensating color optimized retardances (see Col. 18, lines 26-41). The color personalized retardation films 208, 210, and 212 can be seen to be spatially positioned within a pixel in an alignment which corresponds to the RGB color filters 214, 216, and 218. Moreover (see Col. 18, line 54 through Col. 19, line 63), the color personalized retardation films are employed with color optimized orientation so that contrast performance is further improved. Abileah et al. documents (see Figures 13-15 and the associated discussion) that the resulting multi-color display panel with color sub-pixels provides improved peak contrast and angular contrast response in all three color bands as compared to conventional prior devices. A specific example is provided by Abileah et al. (see Col. 18, lines 26-42) wherein the red retarder 212 has a designed retardance of 315 nm, the green retarder 210 has a designed retardance of 275 nm, and blue retardation film 208 has a designed retardance of 240 nm.

The prior art Abileah et al. patent then discloses further embodiments of multi-color sub-pixel LCDs. For example, in the second embodiment device of Figure 16 (see Col. 22, lines 9-11 and Col. 23, lines 6-14),

the color personalized retardation films 50, 52, and 54 are formed using one material for all three retardation films, and varying the thickness thereof to create different retardation values (see Col. 24, lines 14-22). Likewise, the third embodiment device of the Abileah et al. prior art patent, shown in Figure 17, provides an exemplary device in which only the red and green sub-pixels are provided with retardation films (see Col. 26, lines 54-61), although RGB color filters 42, 44, and 46 are provided for the respective color sub-pixels. In this case (see Col. 26, lines 62-67), a constant retardation film 60 is provided which provides retardance for all three colors. Therefore, the total retardance for a red sub-pixel is then obtained by combining the red retardance of the red retarder 80 and the constant retardation film 60.

The Applicant notes that the Examiner has made specific reference to the exemplary device of the Abileah et al. prior art patent which is disclosed in reference to Figure 18. The Applicant respectfully observes that Abileah et al. describes (see Col. 27, lines 24-67) the Figure 18 device as a fourth embodiment for a display panel with red, green, and blue sub-pixels in which color personalized retardation films are provided in a spatially variant manner. The Figure 18 device is similar to the previously discussed Figure 16 device of Abileah et al., in that the thickness of the retarder material (film 62) is variable with color (see Col. 27, lines 24-35). However, unlike the Figure 16 device, the retarders are formed as a continuous terraced film rather than as a series of discrete adjacent retarders.

The Examiner is generally correct that the prior art Abileah et al. patent describes an LCD display panel with a patterned compensator/retarder 62 having a spatially variant retardance. However, the spatially variant retardances of Abileah et al. are provided in relation to color sub-pixelization of the LCD panel, with the spatially variant retarder integrated into the construction of the LCD panel itself. The present application does not teach color sub-pixelization within an LCD display panel, not the design of color corrective retardances that would be associated with such color sub-pixels. Rather, the present application describes a spatially variant compensator that is fabricated to correct for the spatially variant retardance of a pre-existing spatial light modulator or LCD. Additionally, the prior art Abileah et al. patent is deliberately creating non-uniform retardances within a pixel (nominally comprising at least one each of a

red, green, and blue sub-pixel), such that the retardance varies on a micro-scale. The prior art Abileah et al. patent does not address retardance variations that occur on a macro-scale, that is over the full length and width of a device, as does the present invention. As noted in the present application (see page 37, lines 15-19), retardance can vary on a macro-scale across a liquid crystal device for a variety of reasons, including cell gap thickness variation, variations in the LC pre-tilt angle, index and thickness variations in the dielectric stacks of the internal anti-reflection coatings, and voltage noise from variations in the underlying CMOS circuitry. The prior art Abileah et al. patent does not mention these sources of retardance variation, does not generally anticipate a gradually varying spatial retardance, and does not teach the correction thereof in order to provide a nominally constant or uniform retardance from pixel to pixel. In particular, if the nominal cell gap of an Abileah et al. type LCD (thickness “d” or thickness of LC layer 38 of Figure 18) varied from one pixel to another across the device, the color optimized variable retardances of Abileah et al. are formed at prescribed nominal values, and therefore they would not correct for that effect.

By comparison, the present invention explicitly discusses the problem of spatial light modulators (LCDs) having a spatially variant retardance across a device. In the present invention, it is observed (see page 37, lines 11-12) that spatial retardance variation in LCDs can be at least $\pm 15\%$ (for example 10 nm ± 1.5 nm) across a device. In actuality, retardance variations of $\pm 30\%$ have been observed. The present application proposes a new type of polarization compensator in which the compensator retardance is varied spatially so as to correct for the spatial retardance variation across the device. Accordingly, the present invention provides (see page 40, lines 14-22) that patterned compensator 550 can have a spatially variant effective retardance, wherein the localized effective retardances are negative. The intent then is that the negative retardance is at its greatest magnitude where the LCD 210 has its minimum retardance, such that in combination, a uniform retardance is provided. As another example, patterned compensator 550 can also have a spatially variant retardance comprising positive retardances, where there is less retardance where the LCD 210 has more retardances, and visa-versa, such that a uniform retardance is provided. Clearly then, the present invention is directed towards providing a polarization compensator that can correct for macro- or gradual variations in retardance across

a device. The polarization compensator of the present invention may also provide spatially variant retardances that correct for relatively “fast” retardance variations that might occur across just a few pixels, or even from pixel to pixel, but it is not intended to correct color (red vs. blue, for example) dependent retardance variations within a pixel.

The resulting spatially variant compensator of the present invention is nominally described as being used in combination with a pre-existing spatial light modulator, with said compensator residing external and adjacent to the modulator, rather than integrated into the modulator. The prior art Abileah et al. patent only discloses spatially variant compensators that are integrated into the LCD device (see Figure 18, between substrates 34 and 40). Certainly the spatially variant polarization compensator of the present invention could be incorporated or integrated into the modulator. However, that would likely require that the spatially variant retardance of a modulator design be predictable, either by modeling or measurement, as well as repeatable, from device to device across a production run. Additionally, the present application shows an exposure station (see Figure 12) for use in fabricating the spatially variant compensator which is used with a pre-existing modulator. The prior art Abileah et al. patent does not anticipate such an exposure station which can be used with a pre-existing modulator.

Finally, as noted in the present application (see page 39, lines 22-25), the spatially variant compensator and modulator pair of the present application are best realized when the compensator and modulator are used with light of a single given color band, rather than with polychromatic or multi-color light. As the patterned compensator of the present application is intended to make the net retardance from the compensator/modulator combination uniform or constant in value, then it is best if retardance variations from wavelength dispersion are reduced. By comparison, Abileah et al. explicitly provides a multi-color device using integrated color filters and color dependent retarders, which is illuminated with white light.

In summary, the polarization compensator of the present invention, having a spatially variant retardance, is different from that of the prior art Abileah et al. patent in many respects, including:

- The compensator of the present application nominally provides retardance corrections across the full extent of a modulator to make the effective retardance of the modulator constant or uniform across the device. The Abileah et al. patent does not anticipate the problem of pixel to pixel retardance variations (either on a micro- or macro-scale) and does not correct for it.
- The compensator of the present application does not teach sub-pixelated spatial retardance variation, and the correction thereof. The prior art Abileah et al. patent explicitly proves a compensator with sub-pixelated retardances.
- The compensator of the present application can be used external to the modulator, and can be made with a pre-existing modulator acting as a template. The prior art Abileah et al. patent explicitly provides a compensator that is integrated into the construction of the display device.
- The compensator of the present invention will work best when it is used in combination with a modulator within a light beam of a limited spectral band (such as a single color). The prior art Abileah et al. patent explicitly provides a device that is optimized for use within a polychromatic or multi-color light beam, and use of said device within a mono-chromatic light beam would be a waste of an expensive device.

Given these various difference between the Abileah et al. prior art reference and the present application, the Applicant submits that claim 12 is not anticipated by Abileah et al., and is therefore non-obvious, distinct, and patentable.

Rejection Under 35 U.S.C. § 103

The Examiner has rejected claim 13 under 35 U.S.C. 103(a) as being unpatentable over Abileah et al. (U.S. 5,499,126) in view of Koch et al. (U.S. 5,619,352). This rejection is respectfully traversed.

The Applicant was generally aware of this prior art Koch et al. patent when the present application was filed. In particular, the present application briefly discusses (see page 8, lines 2-5 and page 22, lines 10-14) that the Koch et al. patent discloses the design of multi-layer polarization compensators fabricated from organic polymer film materials. The Examiner has

correctly observed that the prior art Koch et al. patent discloses the design and fabrication of polarization compensators fabricated from liquid crystal polymers.

The Applicant respectfully observes that the prior art Koch et al. patent does not discuss or anticipate the problem disclosed in the present invention, in which a polarization compensator with a spatially variant retardance is fabricated for the purpose of correcting the spatially variant retardance of a spatial light modulator, such as a liquid crystal device. As these elements of the present invention are described in claim 12, which has been previously shown to be novel and distinct from the prior art, including the Abileah et al. patent, and as the claim in question, claim 13, is a dependent claim linked to the patentable independent claim 12, then claim 13 is determined to be patentable despite the presence of the prior art Koch et al. patent.

The Examiner has rejected claim 14 under 35 U.S.C. 103(a) as being unpatentable over Abileah et al. (U.S. 5,499,126) in view of Gunning, III et al. (U.S. 5,638,197). This rejection is respectfully traversed.

Although the Applicant did not cite the Gunning, III et al. patent in the present invention, the Applicant was generally aware of prior art related to the design and construction of inorganic thin film compensators, such as that disclosed by Gunning, III et al. In particular, the present invention acknowledges (see page 37, lines 8-10) prior art U.S. Patent No. 5,196,953 by P. Yeh et al. as disclosing polarization compensators made using optical thin film deposition techniques. The Applicant observes that the prior art Gunning, III et al. and Yeh '953 patents have a common assignee (Rockwell International Corp.) and common inventorship, including William J. Gunning, III and John P. Eblen, Jr. Given this common background, it readily follows that the Examiner has correctly identified relevant prior art which cites the construction of polarization compensators fabricated with inorganic materials.

The Applicant respectfully observes that the prior art Gunning, III et al. patent does not discuss or anticipate the problem disclosed in the present invention, in which a polarization compensator with a spatially variant retardance is fabricated for the purpose of correcting the spatially variant retardance of a spatial light modulator, such as a liquid crystal device. As these elements of the present invention are described in claim 12, which has been previously shown to be novel and distinct from the prior art, including the Abileah et al. patent, as the

claim in question, claim 14, is a dependent claim linked to the patentable independent claim 12, then claim 14 is determined to be patentable despite the presence of the prior art Gunning, III et al. patent.

Allowable Subject Matter

The Examiner has allowed claims 1-11 and 15-28.

CONCLUSION

Dependent claims not specifically addressed add additional limitations to the independent claims, which have been distinguished from the prior art and are therefore also patentable.

In conclusion, none of the prior art cited by the Examiner discloses the limitations of the claims of the present invention, either individually or in combination. Therefore, it is believed that the claims are allowable.

If the Examiner is of the opinion that additional modifications to the claims are necessary to place the application in condition for allowance, he is invited to contact Applicant's attorney at the number listed below for a telephone interview and Examiner's amendment.

Respectfully submitted,

A handwritten signature in black ink, appearing to be 'Nelson A. Blish', written over a horizontal line.

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